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Nuclear phase-out in Germany

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Nuclear phase-out in Germany

Most of the nuclear power plants that had been buildt in Germany have already been shut down.
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Final shut downs of commercial NPP

• before the first phase out law (< 2002): 12 NPP
• following the first phase out law (2002): 3 NPP
• following the second phase out law (2011): 9 NPP

Still operating with last shutdown in 2022: 8 NPP
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Status of shutdowns as consequence of the second phase out law (2011):

2011: Biblis A
      Biblis B
      Neckarwestheim 1
      Brunsbüttel
      Isar 1
      Unterweser
      Philippsburg 1
      Krümmel

2015: Grafenrheinfeld
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Shutdown schedule of operating NPP:

- 30.06.2015: Grafenrheinfeld
- 31.12.2021: Grohnde
- 31.12.2022: Isar 2
  - Gundremmingen C
  - Brokdorf
  - Emsland
  - Neckarwestheim 2
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Deutschland: Atomkraftwerke in Betrieb
1961 - 2022 (nach Ausstiegsbeschluss von 2011)
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Ministerpresident of Baden Württemberg (1973): *Planning an industrielle region in the southern Rhine-Valley on the basis of six nuclear power plants*
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Opposition 1975 against the Wyhl NPP
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Occupation of the Wyhl-NPP construction site 1975
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Consensus with the utilities (2000)
1st Phase – Out – Law 2002:

- Limitation of the amounts of nuclear power allowed to be produced - corresponding to 32 years of lifetime.
  => last NPP shut down around 2022
- Amounts of nuclear power can be shifted from older plants to new plants
- Stop of reprocessing nuclear fuel
- Storage of irradiated fuel decentralized at the NPP sites

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Intermediate Renaissance of Nuclear Energy in Germany 2010 (Life time extension act)

+ **8 years** for old plants (start of operation <= 1980): 8 NPP
+ **14 years** for younger plants (start of operation > 1980): 9 NPP

=> last shut-down around 2036
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Angela Merkel, March 13th 2011:

„That what had been absolut unlikely has happened. This gives reason to make an new assessment of nuclear energy.“
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Conclusion of the Ethics-Commission of the Federal German Parliament May 2011:

„Phasing out nuclear energy is necessary and is recommended by the Commission in order to eliminate the risks that result from nuclear power in Germany. It is a possible way because of existing alternatives with less risks.“

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First phase out act: 2002 => 20 NPP until 2022

Life Time extension act: 2010 => 17 NPP until 2036

Back to the start:
Second phase out act: 2011 => 8 NPP in 2011
=> 9 NPP until 12/2022
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Assessment of the Utilities’ lawsuits for compensation:

- Vattenfall (ICSID): 4.5 Billion
- RWE, EON, Vattenfall (3 Month shutdown): 0.9 Billion
- RWE, EON, Vattenfall (constitutional court): 5 - 10 Billion?
- RWE, EON, Vattenfall, ENBW (repayment fuel taxes): 5 Billion

Sum of demanded compensation (assessed) : ~ 20 Billion

Open: Which part of the costs for the management and the disposal of radioactive waste will not be financed by the utilities? 10 - 50 Billion*

*assessed
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Reasons why a nuclear phase out in Germany should not go

- The potential of renewables to compensate nuclear energy to weak, Renewables are economically not competitive
- Loss of power production cannot be compensated, danger of black outs:
- Germany will have to import electric power and will become more dependent
- CO2 production will rise
- The economic development will suffer; industry will leave
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SAIDI—unplanned interruptions, excluding exceptional events

Report on the German power system, AGORA 2015, 35
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Important policies and historical events

Renewable energy

1976: Start of the Anti-Nuclear Movement
1987: Chernobyl accident
1990: 1st Feed-in tariffs law
2000: Renewable Energy Act (EEG)
2000: Revision of the 1st Nuclear Phase-Out Law
2010: Energy Concept
2011: Fukushima Accident
2011: 2nd Nuclear Phase-Out Law
2014: Renewable Energy Act 2.0 (EEG 2.0)

Nuclear energy

1970-2025

[Wh]

- Nuclear
- Renewables

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Structure of gross electricity generation in Germany, 1990 - 2014

Source: Die Energiewende im Stromsektor: Stand der Dinge 2015, AGORA 2016, 13
The German NPP - Phase - Out

Contribution of renewables to the electricity supply

BMWi, 2014d., Öko-Institut 2014
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Production of electricity 2015

Source: Die Energiewende im Stromsektor: Stand der Dinge 2015, AGORA 2016, 12
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Development of renewables

Source: Die Energiewende im Stromsektor: Stand der Dinge 2015, AGORA 2016, 17
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Measures to limit the growth of the renewables

Annual capacity targets:

Maximum yearly capacity targets of

- 2500 MW of PV,
- 2500 MW of wind offshore,
- 800 MW of wind onshore and
- 100 MW of biomass.

Feed-in tariffs are adjusted automatically depending on whether the technology-specific targets are met.
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Net electricity exports from Germany to its neighbours (physical flows), 2000-2014

Source, Understanding the Energiewende, AGORA, 23
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Decoupling of economic growth and Energy consumption

Source: Die Energiewende im Stromsektor: Stand der Dinge 2015, AGORA 2016, 17
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CO-2 production of the electricity sector

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Source: Understanding the Energiewende, AGORA 2015, 30
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Comparison of end-use electricity prices in 2012 for energy intensive industries (150 GWh annual consumption)

Agora Energiewende 2014.b

Report on the German power system, AGORA 2015, 25
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Electricity Prices of households

BNetzA2015; Werte für 2016*: AGORA Schätzung; R
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Average electricity prices for households and industrial consumers, 2013

**Households**
Annual consumption 3,500 kWh/a

**Industry**
Annual consumption 24 GWh, maximum load 4 MW/6,000 h/a, medium voltage

**Energy-intensive industry**
Annual consumption 1,950 GWh, maximum load 225 MW/8,000 h/a, high voltage

<table>
<thead>
<tr>
<th>Country</th>
<th>Price [€/kWh]</th>
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<tbody>
<tr>
<td>Germany (Households)</td>
<td>29.2</td>
</tr>
<tr>
<td>Germany (Industry)</td>
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<td>Germany (Energy-intensive)</td>
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<td>Texas</td>
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BNetzA (2014b), Ecofys/ISI (2014)
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Political an public support of the Energiewende

Voting results in the Bundestag on Energiewende

- 85% of MPs voted for the Energiewende (2011)
- 100% of political parties in parliament agree that there will be no lifetime extension for nuclear power plants

Public opinion on Energiewende

- 90% of German citizens think that the goals of the Energiewende are right (2015)
- 45% of German citizens think that the Energiewende is making good progress

Source: Understanding the Energiewende, AGORA 2015, 10
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Ownership share of renewable generation in Germany, 2012

- Private citizens and farmers: 46%
- Project developers: 14%
- Industry: 14%
- Funds/banks: 13%
- Regional/municipal utilities: 7%
- Big four: 5%
- Other: 1%

Report on the German power system, AGORA 2015, 9
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- Elements that stabilize the Energiewende:
  - high Investments in many diversified sectors are bearing the Energiewende; 5% contribution of the utilities;
  - Energiewende is covering all sectors of the economy: electricity production, turbine production, computer sector, heating sector, households, craftsmen 46 % are private citizens and farmers;
  - Energiewende has lost its green colour and has crossed all political borders;

There are many problems of the nuclear phase-out left to solve but it seems that there will be no way back.